Claims

What is claimed is:

1. An automatic control system for a work machine for operating at a work site, the work site containing material to be operated on by the work machine, comprising:

a positioning system operable to determine a relative location of the work machine within the work site and produce a machine position signal;

a site model containing data related to a condition of the material; and,

a controller being coupled to the site model operable to receive the machine position signal and determine a current condition of the material as a function of the position signal and the site model, operable to generate a control signal as a function of the current condition of the material and operable to responsively control the work machine as a function of the control signal.

2. An automatic control system, as set forth in claim 1, the work machine has a work implement, the automatic control system further comprising:

at least one implement sensor operable to sense a parameter of the work implement and produce at least one implement signal; and

an implement control system coupled to the work implement operable to control operation of the work implement, the controller operable to receive the at least one implement signal, the control signal being a function of the current condition of the material and the at least one implement signal, the implement control system operable to receive the control signal and responsively control the work implement.

3. An automatic control system, as set forth in claim 1, wherein the data related to a condition of the material stored and contained in the site model is related to traction of the work machine.

4. An automatic control system, as set forth in claim 3, wherein the data related to a condition of the material includes a traction coefficient.

5. An automatic control system, as set forth in claim 4, further comprising a slip detector operable to determine a slip rate value of the work machine and to responsively generate a slip signal, the controller operable to receive the slip signal and determine an actual traction coefficient and operable to update the site model as a function of the actual traction coefficient.

6. An automatic control system, as set forth in claim 1, wherein the positioning system includes a GPS receiver.

7. An automatic control system, as set forth in claim 1, wherein the positioning system includes a laser system.

8. An automatic control system, as set forth in claim 1, the site model including a ground profile, the ground profile being indicative of the contours of the ground previously traversed by the work machine.

9. An automatic control system, as set forth in claim 8, wherein the control signal is further generated as a function of the ground profile.

10. An automatic control system, as set forth in claim 2, wherein the implement control system includes a lift actuator associated with the work implement.

11. An automatic control system, as set forth in claim 10, further comprising:

a ground speed sensor coupled to the work machine operable to sense a ground speed of the work machine and to responsively generate a ground speed signal;

an angular rate sensor operable to sense an angular rate associated with the work machine and to responsively generate an angular rate signal;

a slip detector operable to determine a slip rate value of the work machine and to responsively generate a slip signal; and,

the at least one implement sensor including a position sensor operable to sense a position of the lift actuator and to responsively generate a lift actuator position signal, the controller operable to receive the slip signal, the angular rate signal, the ground speed signal, and the lift actuator position signal and to responsively determine an implement position as a function of the slip signal, the angular rate signal and the lift actuator position signal, the control signal being generated as a function of the implement position, the slip signal, and the ground speed signal.

12. An automatic control system, as set forth in claim 1, wherein the control signal is further generated as a function of a predetermined desired ground speed.

13. An automatic control system, as set forth in claim 1, further comprising a sensor operable to detect an actual condition of the material, the controller being operable to update the site model as a function of the actual condition of the material.

14. An automatic control system, as set forth in claim 1, the controller being operable to determine an expected path of the work machine as a function

of the position signal, the control signal being generated as a function of the expected path.

15. An automatic control system, as set forth in claim 1, where the date related to a condition of the material is related to hardness of the material.

16. An automatic control system, as set forth in claim 1, the controller being operable to modify a speed of the work machine as a function of the condition of the material.

17. An automatic control system, as set forth in claim 2, the controller being operable to modify a speed of the work machine as a function of the condition of the material by actuating the work implement.

18. An automatic control system, for a work implement of a work machine, the work machine for operating at a work site, the work site containing material to be operated on by the work implement, comprising:

a positioning system operable to determine a relative location of the work machine within the work site and to produce a position signal;

a site model containing data related to a condition of the material;

a ground speed sensor coupled to the work machine operable to sense a ground speed of the work machine and responsively generate a ground speed signal;

a slope detector operable to determine a slope of the work machine and responsively generate a slope signal;

a slip detector operable to determine a slip rate value of the work machine and responsively generate a slip signal;

an actuator coupled to the work implement operable to control operation of the work implement;

a position sensor coupled to the work implement operable to sense a position of the work implement and responsively generate an implement position signal;

a controller being coupled to the implement control system and the site model, the controller being operable to receive the machine position signal and determine a current condition of the material as a function of the machine position signal and the site model and being operable to receive the slope signal, the slip signal, and the implement position signal and generate a control signal as a function of the slope signal, the slip signal, the implement position signal and the current condition of the material, the implement control system being operable to receive the control signal and responsively control the work implement.

19. An automatic control system, as set forth in claim 18, wherein the data related to a condition of the material stored and contained in the site model is related to traction of the work machine.

20. An automatic control system, as set forth in claim 16, wherein the data related to a condition of the material includes a traction coefficient.

21. An automatic control system, as set forth in claim 17, , the controller being operable to receive the slip signal and determine an actual traction coefficient and operable to update the site model as a function of the actual traction coefficient.

22. An automatic control system, as set forth in claim 15, the site model including a ground profile, the ground profile being indicative of the contours of the ground previously traversed by the work machine.

23. An automatic control system, as set forth in claim 22, wherein the control signal is further generated as a function of the ground profile.

24. An automatic control system, as set forth in claim 18, wherein the control signal is further generated as a function of a predetermined desired ground speed.

25. An automatic control system, as set forth in claim 18, further comprising a sensor operable to detect an actual condition of the material , the controller being operable to update the site model as a function of the actual condition.

26. An automatic control system, as set forth in claim 18, the controller being operable to determine an expected path of the work machine as a function of the position signal, the control signal being generated as a function of the expected path.

27. An automatic control system, as set forth in claim 18, where the data related to a condition of the material is related to hardness of the material.

28. An automatic control system, as set forth in claim 18, the controller being operable to modify a speed of the work machine as a function of the condition of the material.

29. An automatic control system, as set forth in claim 18, the controller being operable to modify a speed of the work machine as a function of the condition of the material by actuating the work implement.

30. An automatic control system, as set forth in claim 18, the slope detector includes at least one of an inclination sensor and an angular rate sensor.

31. A method for controlling a work machine operating at a work site, the work site containing material to be operated on by the work machine, including the steps of:

determining a relative location of the work machine within the work site and producing a machine position signal; and,

receiving the machine position signal and determining a current condition of the material as a function of the position signal and a site model, the site model containing data related to a condition of the material.

32. A method, as set forth in claim 31, the work machine having a work implement, including the steps of :

sensing a parameter of the work implement and producing at least one implement signal;

generating a control signal as a function of the at least one implement signal and the current condition of the material; and,

responsively controlling the work machine as a function of the control signal and the current condition of the material.

33. A method, as set forth in claim 31, wherein the data related to a condition of the material stored and contained in the site model is related to traction of the work machine.

34. A method, as set forth in claim 33, wherein the data related to a condition of the material includes a traction coefficient.

35. A method, as set forth in claim 34, further including the steps of:

determining a slip rate value of the work machine and responsively generating a slip signal;

determining an actual traction coefficient as a function of the slip signal; and

updating the site model as a function of the actual traction coefficient.

36. A method, as set forth in claim 31, wherein the site model includes a ground profile, the ground profile being indicative of the contours of the ground previously traversed by the work machine.

37. A method, as set forth in claim 36, wherein the control signal is further generated as a function of the ground profile.

38. A method, as set forth in claim 31, wherein an implement control system includes a lift actuator associated with a work implement, the method further including the steps of:

sensing a ground speed of the work machine and responsively generating a ground speed signal;

sensing an angular rate associated with the work machine and responsively generating an angular rate signal;

determining a slip rate value of the work machine and responsively generating a slip signal;

sensing a position of the lift actuator and responsively generating a lift actuator position signal; and

determining an implement position as a function of the slip signal, the angular rate signal and the lift actuator position signal, the control signal being a function of the implement position, the slip signal, and the ground speed signal.

39. A method, as set forth in claim 31, including the step of detecting an actual condition of the material and updating the site model as a function of the actual condition.

40. A method, as set forth in claim 31, including the steps of determining an expected path of the work machine as a function of the position signal, the control signal being generated as a function of the expected path.

41. A method, as set forth in claim 31, wherein the data related to a the condition of the material is related to hardness of the material.

42. A method, as set forth in claim 31, including the step of modifying a speed of the work machine as a function of the condition of the material.

43. A method, as set forth in claim 31, including the step of modifying a speed of the work machine as a function of the current condition of the material by actuating a work implement.